

IN THE CLAIMS:

**Please amend** claims 1-12, 23, 34-45, and 56, and add new claims 67-72, as set forth in the complete list of claims that is presented below.

1. (currently amended) A computer-readable medium encoded with a program debugger, for use in a programming environment, comprising:

means for extracting, from an initial conditional breakpoint within a program loop, a first Boolean expression that is at least partially invariant within the loop;  
means for removing said initial conditional breakpoint;  
means for setting, at a pre-ICB pre-initial conditional breakpoint program position, a special conditional breakpoint that includes said first Boolean expression; and  
means for reestablishing said initial conditional breakpoint if said special conditional breakpoint is satisfied.

2. (currently amended) The program debugger computer-readable medium of claim 1, wherein said first Boolean expression is completely invariant within the loop.

3. (currently amended) The program debugger computer-readable medium of claim 1, further comprising:

means for setting, at a first loop exit program position, a first reset breakpoint; and  
means for removing said initial conditional breakpoint if said first reset breakpoint is satisfied.

4. (currently amended) The ~~program debugger~~ computer-readable medium of claim 3, further comprising:

means for removing said first reset breakpoint if said first reset breakpoint is satisfied.

5. (currently amended) The ~~program debugger~~ computer-readable medium of claim 3, further comprising:

means for setting, at a second loop exit program position, a second reset breakpoint; and

means for removing said initial conditional breakpoint if one of said first and second reset breakpoints is satisfied.

6. (currently amended) The ~~program debugger~~ computer-readable medium of claim 5, further comprising:

means for removing said first and second reset breakpoints if one of said first and second reset breakpoints is satisfied.

7. (currently amended) The ~~program debugger~~ computer-readable medium of claim 1, further comprising:

means for extracting, from program code within the loop, a second Boolean expression that is invariant within the loop,

wherein said special conditional breakpoint disjunctively includes the complement of said second Boolean expression, and said first Boolean expression is invariant within the loop when said second Boolean expression is satisfied.

8. (currently amended) The ~~program debugger~~ computer-readable medium computer-readable medium of claim 7, further comprising:

means for setting, at a first loop exit program position, a first reset breakpoint; and means for removing said initial conditional breakpoint if said first reset breakpoint is satisfied.

9. The ~~program debugger~~ computer-readable medium of claim 8, further comprising:

means for removing said first reset breakpoint if said first reset breakpoint is satisfied.

10. (currently amended) The ~~program debugger~~ computer-readable medium of claim 8, further comprising:

means for setting, at a second loop exit program position, a second reset breakpoint; and

means for removing said initial conditional breakpoint if one of said first and second reset breakpoints is satisfied.

11. (currently amended) The ~~program debugger~~ computer-readable medium of claim 10, further comprising:

means for removing said first and second reset breakpoints if one of said first and second reset breakpoints is satisfied.

12. (currently amended) A method of reducing debugger impact through conditional breakpoint motion, comprising:

extracting, from an initial conditional breakpoint within a program loop, a first Boolean expression that is at least partially invariant within the loop;  
removing said initial conditional breakpoint;  
setting, at a ~~pre-ICB~~ pre-initial condition breakpoint program position, a special conditional breakpoint that includes said first Boolean expression; and  
if said special conditional breakpoint is satisfied, reestablishing said initial conditional breakpoint.

13. (original) The method of claim 12, wherein said first Boolean expression is completely invariant within the loop.

14. (original) The method of claim 12, further comprising:  
setting, at a first loop exit program position, a first reset breakpoint; and  
if said first reset breakpoint is satisfied, removing said initial conditional breakpoint.

15. (original) The method of claim 14, further comprising:

if said first reset breakpoint is satisfied, removing said first reset breakpoint.

16. (original) The method of claim 14, further comprising:

setting, at a second loop exit program position, a second reset breakpoint; and

if one of said first and second reset breakpoints is satisfied, removing said initial conditional breakpoint.

17. (original) The method of claim 16, further comprising:

if one of said first and second reset breakpoints is satisfied, removing said first and second reset breakpoints.

18. (original) The method of claim 12, further comprising:

extracting, from program code within the loop, a second Boolean expression that is invariant within the loop,

wherein said special conditional breakpoint disjunctively includes the complement of said second Boolean expression, and said first Boolean expression is invariant within the loop when said second Boolean expression is satisfied.

19. (original) The method of claim 18, further comprising:

setting, at a first loop exit program position, a first reset breakpoint; and

if said first reset breakpoint is satisfied, removing said initial conditional breakpoint.

20. (original) The method of claim 19, further comprising:

if said first reset breakpoint is satisfied, removing said first reset breakpoint.

21. (original) The method of claim 19, further comprising:

setting, at a second loop exit program position, a second reset breakpoint; and

if one of said first and second reset breakpoints is satisfied, removing said initial conditional breakpoint.

22. (original) The method of claim 21, further comprising:

if one of said first and second reset breakpoints is satisfied, removing said first and second reset breakpoints.

23. (currently amended) An article of manufacture comprising a computer program medium readable by a computer and embodying one or more instructions executable by the computer to perform a method of reducing debugger impact through conditional breakpoint motion, the method comprising:

extracting, from an initial conditional breakpoint within a program loop, a first Boolean expression that is at least partially invariant within the loop;  
removing said initial conditional breakpoint;

setting, at a ~~pre-ICB~~ pre-initial conditional breakpoint program position, a special conditional breakpoint that includes said first Boolean expression; and

if said special conditional breakpoint is satisfied, reestablishing said initial conditional breakpoint.

24. (original) The article of manufacture of claim 23, wherein the first Boolean expression is completely invariant within the loop.

25. (original) The article of manufacture of claim 23, wherein the method further comprises:

setting, at a first loop exit program position, a first reset breakpoint; and  
if said first reset breakpoint is satisfied, removing said initial conditional breakpoint.

26. (original) The article of manufacture of claim 25, wherein the method further comprises:

if said first reset breakpoint is satisfied, removing said first reset breakpoint.

27. (original) The article of manufacture of claim 25, wherein the method further comprises:

setting, at a second loop exit program position, a second reset breakpoint; and

if one of said first and second reset breakpoints is satisfied, removing said initial conditional breakpoint.

28. (original) The article of manufacture of claim 27, wherein the method further comprises:

if one of said first and second reset breakpoints is satisfied, removing said first and second reset breakpoints.

29. (original) The article of manufacture of claim 23, wherein said first Boolean expression is partially invariant within the loop, and the method further comprises:

extracting, from program code within the loop, a second Boolean expression that is invariant within the loop,

wherein said special conditional breakpoint disjunctively includes the complement of said second Boolean expression, and said first Boolean expression is invariant within the loop when said second Boolean expression is satisfied.

30. (original) The article of manufacture of claim 29, wherein the method further comprises:

setting, at a first loop exit program position, a first reset breakpoint; and if said first reset breakpoint is satisfied, removing said initial conditional breakpoint.

31. (original) The article of manufacture of claim 30, wherein the method further comprises:

if said first reset breakpoint is satisfied, removing said first reset breakpoint.

32. (original) The article of manufacture of claim 30, wherein the method further comprises:

setting, at a second loop exit program position, a second reset breakpoint; and  
if one of said first and second reset breakpoints is satisfied, removing said initial conditional breakpoint.

33. (original) The article of manufacture of claim 32, wherein the method further comprises:

if one of said first and second reset breakpoints is satisfied, removing said first and second reset breakpoints.

34. (currently amended) A computer-readable medium encoded with a program debugger, for use in a programming environment, comprising:

means for extracting, from an initial conditional breakpoint within a program loop, a first Boolean expression that is at least partially invariant within the loop;

means for setting, at a ~~pre-ICB~~ pre-initial conditional breakpoint program position, a special conditional breakpoint that includes the complement of said first Boolean expression; and

means for removing said initial conditional breakpoint if said special conditional breakpoint is satisfied.

35. (currently amended) The ~~program-debugger~~ computer-readable medium of claim 34, wherein said first Boolean expression is completely invariant within the loop.

36. (currently amended) The ~~program-debugger~~ computer-readable medium of claim 34, further comprising:

means for setting, at a first loop exit program position, a first reset breakpoint; and  
means for reestablishing said initial conditional breakpoint if said first reset breakpoint is satisfied.

37. (currently amended) The ~~program-debugger~~ computer-readable medium of claim 36, further comprising:

means for removing said first reset breakpoint if said first reset breakpoint is satisfied.

38. (currently amended) The ~~program-debugger~~ computer-readable medium of claim 36, further comprising:

means for setting, at a second loop exit program position, a second reset breakpoint; and

means for reestablishing said initial conditional breakpoint if one of said first and second reset breakpoints is satisfied.

39. (currently amended) The ~~program-debugger~~ computer-readable medium of claim 38, further comprising:

means for removing said first and second reset breakpoints if one of said first and second reset breakpoints is satisfied.

40. (currently amended) The ~~program-debugger~~ computer-readable medium of claim 34, wherein said first Boolean expression is partially invariant within the loop, and said program debugger further comprises:

means for extracting, from program code within the loop, a second Boolean expression that is invariant within the loop,

wherein said special conditional breakpoint conjunctively includes said second Boolean expression, and said first Boolean expression is invariant within the loop when said second Boolean expression is satisfied.

41. (currently amended) The ~~program-debugger~~ computer-readable medium of claim 40, further comprising:

means for setting, at a first loop exit program position, a first reset breakpoint; and

means for reestablishing said initial conditional breakpoint if said first reset breakpoint is satisfied.

42. (currently amended) The ~~program debugger~~ computer-readable medium of claim 41, further comprising:

means for removing said first reset breakpoint if said first reset breakpoint is satisfied.

43. (currently amended) The ~~program debugger~~ computer-readable medium of claim 41, further comprising:

means for setting, at a second loop exit program position, a second reset breakpoint; and

means for reestablishing said initial conditional breakpoint if one of said first and second reset breakpoints is satisfied.

44. (currently amended) The ~~program debugger~~ computer-readable medium of claim 43, further comprising:

means for removing said first and second reset breakpoints if one of said first and second reset breakpoints is satisfied.

45. (currently amended) A method of reducing debugger impact through conditional breakpoint motion, comprising:

extracting, from an initial conditional breakpoint within a program loop, a first Boolean expression that is at least partially invariant within the loop; setting, at a ~~pre-ICB~~ pre-initial conditional breakpoint program position, a special conditional breakpoint that includes the complement of said first Boolean expression; and if said special conditional breakpoint is satisfied, removing said initial conditional breakpoint.

46. (original) The method of claim 45, wherein said first Boolean expression is completely invariant within the loop.

47. (original) The method of claim 45, further comprising:  
setting, at a first loop exit program position, a first reset breakpoint; and  
if said first reset breakpoint is satisfied, reestablishing said initial conditional breakpoint.

48. (original) The method of claim 47, further comprising:  
if said first reset breakpoint is satisfied, removing said first reset breakpoint.

49. (original) The method of claim 47, further comprising:  
setting, at a second loop exit program position, a second reset breakpoint; and  
if one of said first and second reset breakpoints is satisfied, reestablishing said initial conditional breakpoint.

50. (original) The method of claim 49, further comprising:  
if one of said first and second reset breakpoints is satisfied, removing said first and  
second reset breakpoints.

51. (original) The method of claim 45, further comprising:  
extracting, from the program code within the loop, a second Boolean expression  
that is invariant within the loop,  
wherein said special conditional breakpoint conjunctively includes said second  
Boolean expression, and said first Boolean expression is invariant within the loop when  
said second Boolean expression is satisfied.

52. (original) The method of claim 51, further comprising:  
setting, at a first loop exit program position, a first reset breakpoint; and  
if said first reset breakpoint is satisfied, reestablishing said initial conditional  
breakpoint.

53. (original) The method of claim 52, further comprising:  
if said first reset breakpoint is satisfied, removing said first reset breakpoint.

54. (original) The method of claim 52, further comprising:  
setting, at a second loop exit program position, a second reset breakpoint; and

if one of said first and second reset breakpoints is satisfied, reestablishing said initial conditional breakpoint.

55. (original) The method of claim 54, further comprising:  
if one of said first and second reset breakpoints is satisfied, removing said first and second reset breakpoints.

56. (currently amended) An article of manufacture comprising a computer program medium readable by a computer and embodying one or more instructions executable by the computer to perform a method of reducing debugger impact through conditional breakpoint motion, the method comprising:

extracting, from an initial conditional breakpoint within a program loop, a first Boolean expression that is at least partially invariant within the loop;  
setting, at a pre-ICB pre-initial conditional breakpoint program position, a special conditional breakpoint that includes the complement of said first Boolean expression; and  
if said special conditional breakpoint is satisfied, removing said initial conditional breakpoint.

57. (original) The article of manufacture of claim 56, wherein said first Boolean expression is completely invariant within the loop.

58. (original) The article of manufacture of claim 56, wherein the method further comprises:

setting, at a first loop exit program position, a first reset breakpoint; and  
if said first reset breakpoint is satisfied, reestablishing said initial conditional  
breakpoint.

59. (original) The article of manufacture of claim 58, wherein the method further comprises:

if said first reset breakpoint is satisfied, removing said first reset breakpoint.

60. (original) The article of manufacture of claim 58, wherein the method further comprises:

setting, at a second loop exit program position, a second reset breakpoint; and  
if one of said first and second reset breakpoints is satisfied, reestablishing said  
initial conditional breakpoint.

61. (original) The article of manufacture of claim 60, wherein the method further comprises:

if one of said first and second reset breakpoints is satisfied, removing said first and  
second reset breakpoints.

62. (original) The article of manufacture of claim 56, wherein the method further comprises:

extracting, from the program code within the loop, a second Boolean expression that is invariant within the loop,  
wherein said special conditional breakpoint conjunctively includes said second Boolean expression, and said first Boolean expression is invariant within the loop when said second Boolean expression is satisfied.

63. (original) The article of manufacture of claim 62, wherein the method further comprises:

setting, at a first loop exit program position, a first reset breakpoint; and if said first reset breakpoint is satisfied, reestablishing said initial conditional breakpoint.

64. (original) The article of manufacture of claim 63, wherein the method further comprises:

if said first reset breakpoint is satisfied, removing said first reset breakpoint.

65. (original) The article of manufacture of claim 63, wherein the method further comprises:

setting, at a second loop exit program position, a second reset breakpoint; and

if one of said first and second reset breakpoints is satisfied, reestablishing said initial conditional breakpoint.

66. (original) The article of manufacture of claim 65, wherein the method further comprises:

if one of said first and second reset breakpoints is satisfied, removing said first and second reset breakpoints.

67. (new) The computer-readable medium of claim 1, wherein the initial conditional breakpoint occurs at a program statement in the loop that has been designated by an operator of the program debugger.

68. (new) The method of claim 12, wherein the initial conditional breakpoint occurs at a program statement in the loop that has been designated by an operator of the program debugger.

69. (new) The article of manufacture of claim 23, wherein the initial conditional breakpoint occurs at a program statement in the loop that has been designated by an operator of the program debugger.

70. (new) The computer-readable medium of claim 34, wherein the initial conditional breakpoint occurs at a program statement in the loop that has been designated by an operator of the program debugger.

71. (new) The method of claim 45, wherein the initial conditional breakpoint occurs at a program statement in the loop that has been designated by an operator of the program debugger.

72. (new) The article of manufacture of claim 56, wherein the initial conditional breakpoint occurs at a program statement in the loop that has been designated by an operator of the program debugger.